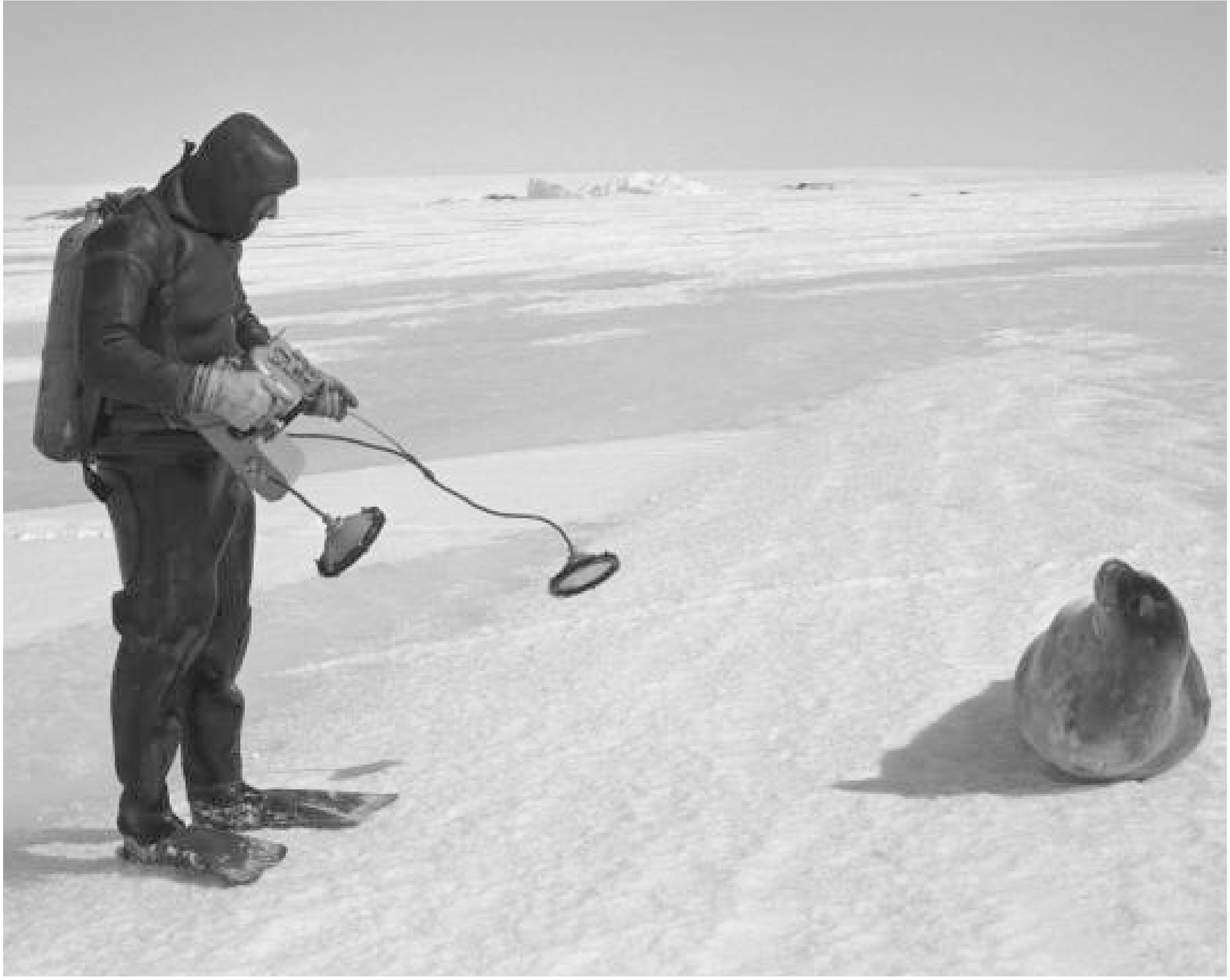
Scuba Diving on the 11th Soviet Antarctic Expedition

Peter Brueggeman, 2022

Russian scientists **Mikhail V Propp** (at left), **Eugene N Gruzov**, and **Alexander F Pushkin** (both pictured below) were diving under the ice from December 6, 1965 to March 30, 1966 in the vicinity of Mirnyy Station in the Davis Sea, along the mainland and in the adjacent Haswell Islands [1,2]. Conducted during the 11th Soviet Antarctic Expedition, many of their 144 dives were made under the ice at depths down to fifty meters, for dive durations up to 70 minutes [1,2]. Divers under the ice were tethered by a nylon cord 6mm in diameter [1]. By the end of February, the ice had broken out and the remaining dives were made from a small boat [1].

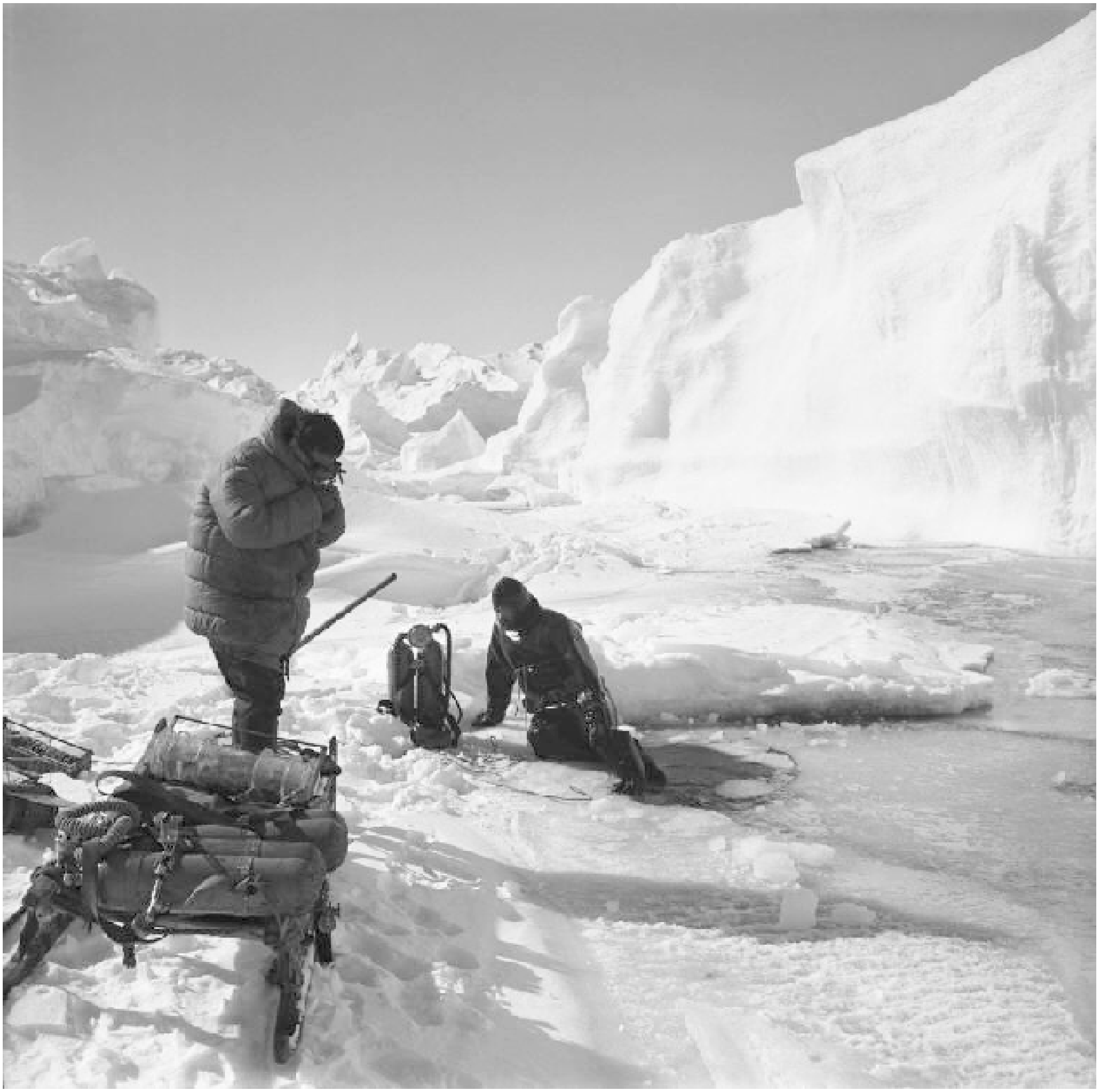
This project used two types of aqualungs (AVM-1 and AVM-1M), and two types of diver suits, a GKP-4 (with the diver helmet removed, and with an air equalization tube running from the aqualung mouthpiece to a chest fitting), and a close fitting foam rubber suit of 6mm thickness (into which air entered from the diver's mask seal) [1]. Two sets of diver underwear were worn under the GKP-54 suit, one being rubberized cloth and the other wool [1]. Less underwear was worn under the foam rubber suit, due to its better thermal protection [1]. A helmet from the ISAM-48 or KIP-7 apparatus was used with an ordinary mask set into it [1]. Their hands were least protected, wearing thin rubber gloves over wool gloves [1].



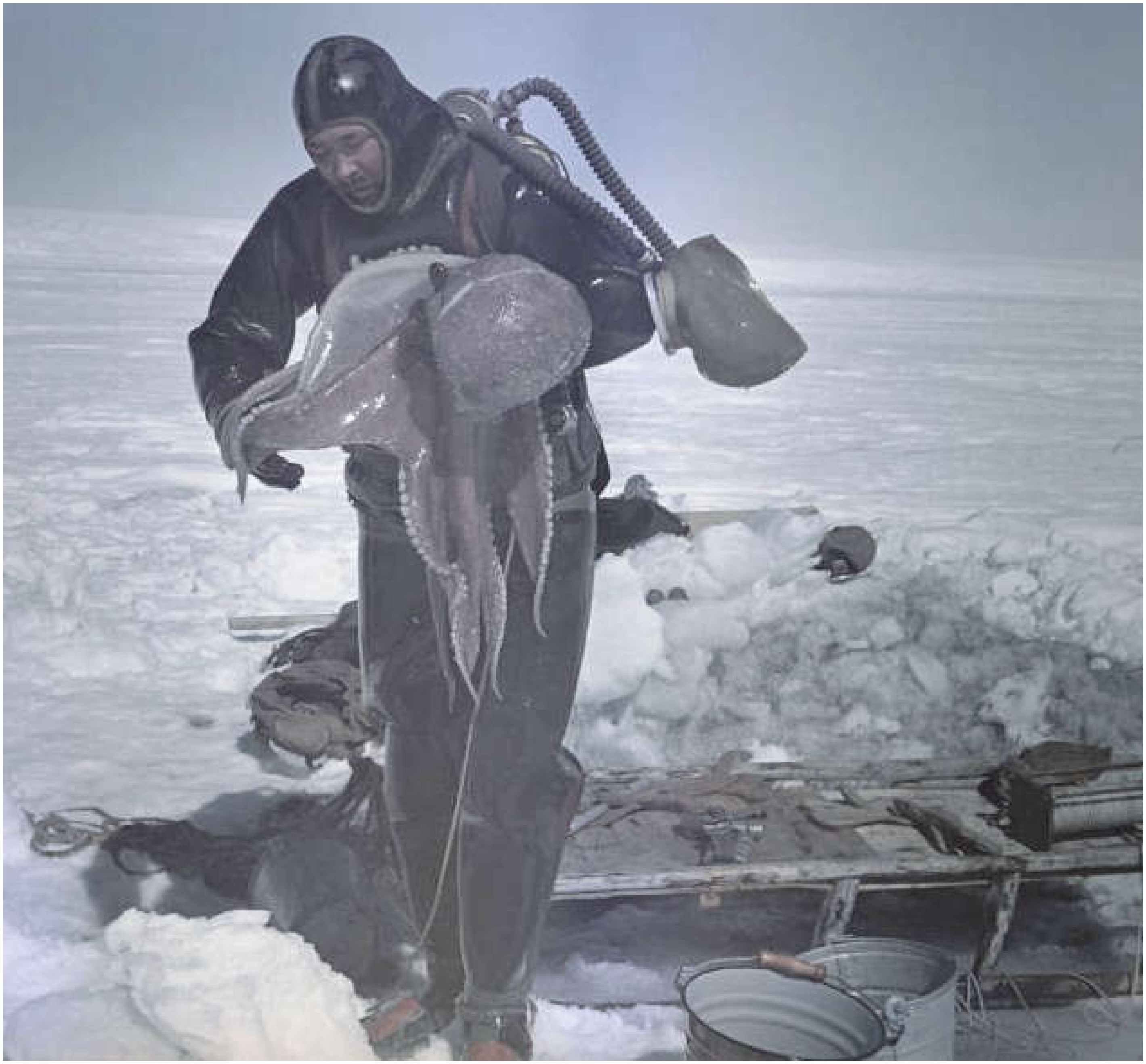
Here’s Mikhail Propp with his underwater camera gear and a Weddell seal, February 1966, near Mirnyy Station (SIO Archives)

Dive holes were opened by explosions of 0.5-15 kilograms of TNT, depending on the ice thickness [1]. For underwater photography, Iskra and Leningrad (with wide angle Yu12 lens) cameras in underwater housings were used, with two flash units having 130 J power supplied by a GB-300 battery [1].

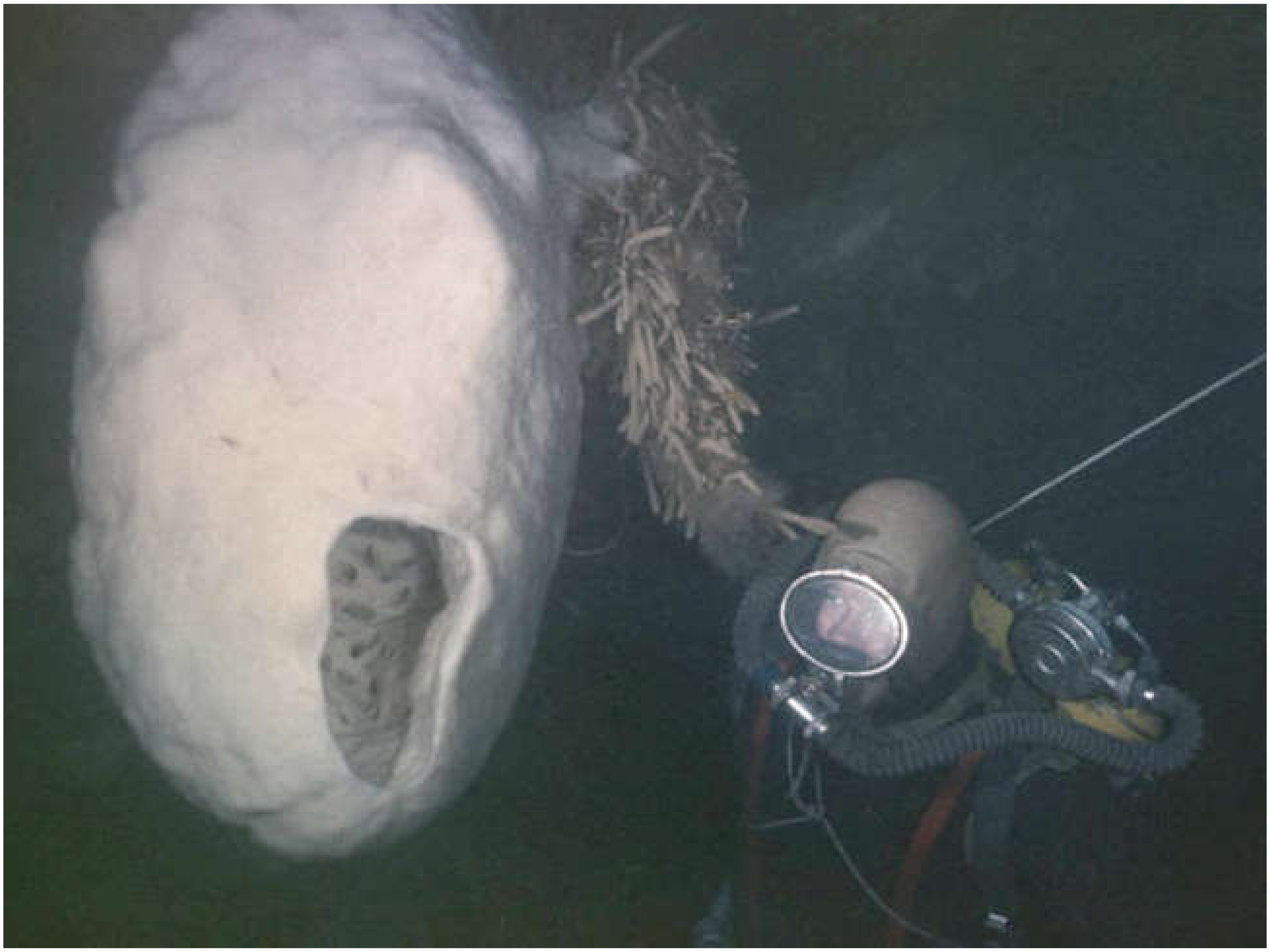
Eugene Gruzov (left) and Alexander Pushkin (right), with specimen collecting device, Mirnyy Station, February 1966 (SIO Archives)



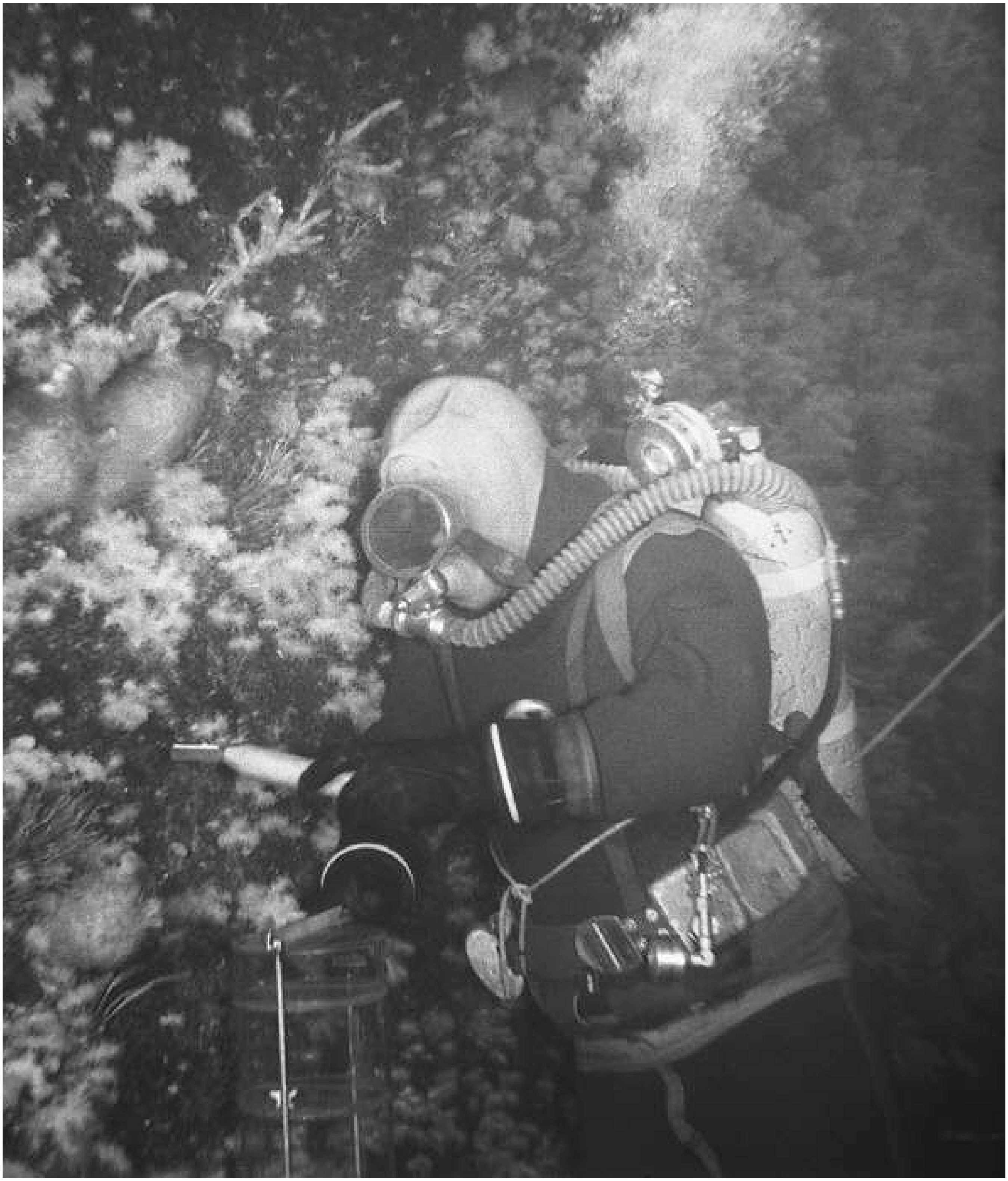
Eugene Gruzov (left) and diver Alexander Pushkin at dive hole, near Mirnyy Station, February 1966 (SIO Archives)



Alexander Pushkin with octopus, Tokarev Island in the Haswell Islands, near Mirnyy Station, February 1966
(SIO Archives)

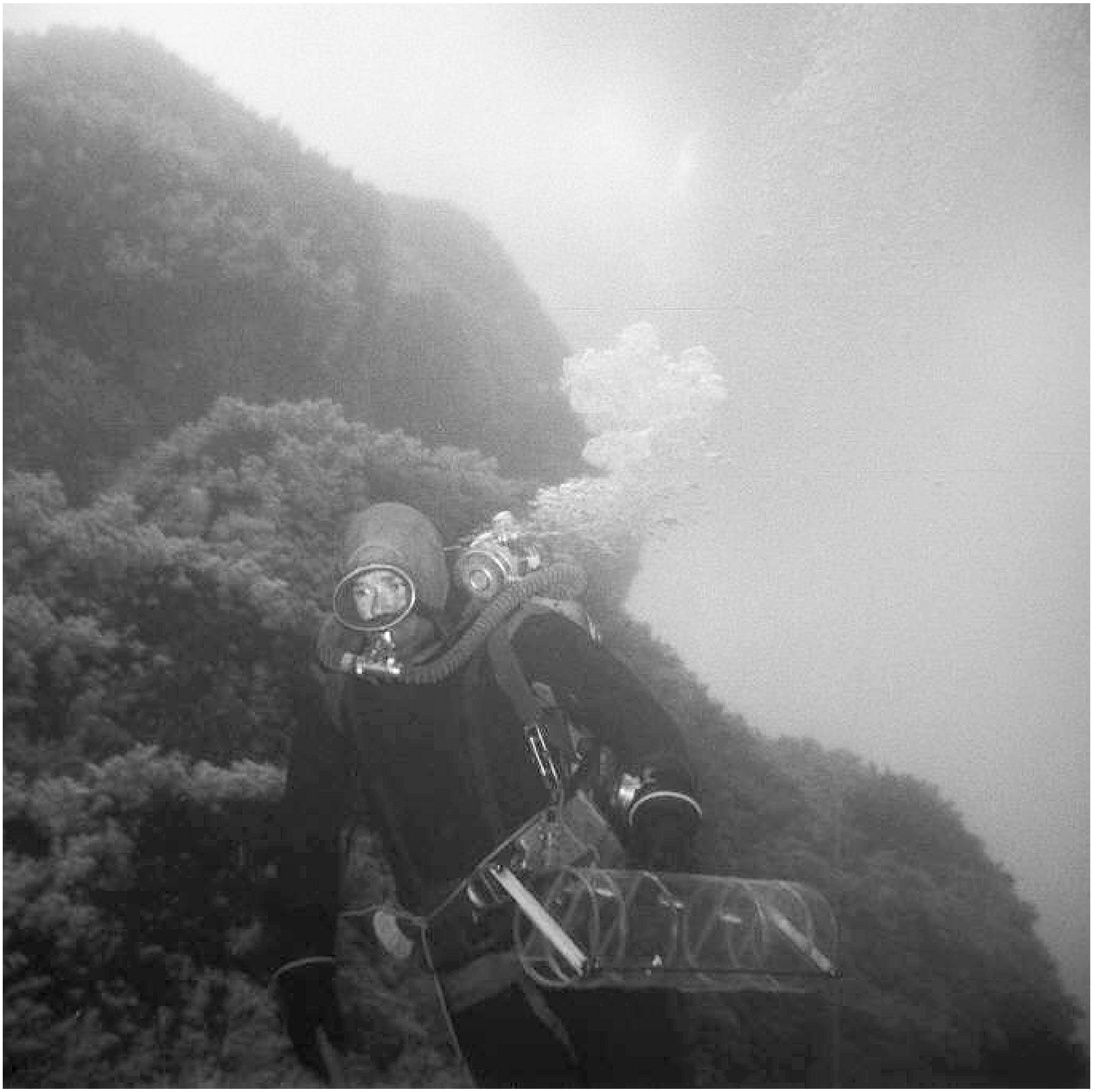


Alexander Pushkin with volcano sponge *Anoxycalyx (Scolymastra) joubini*, January 1966 (SIO Archives)

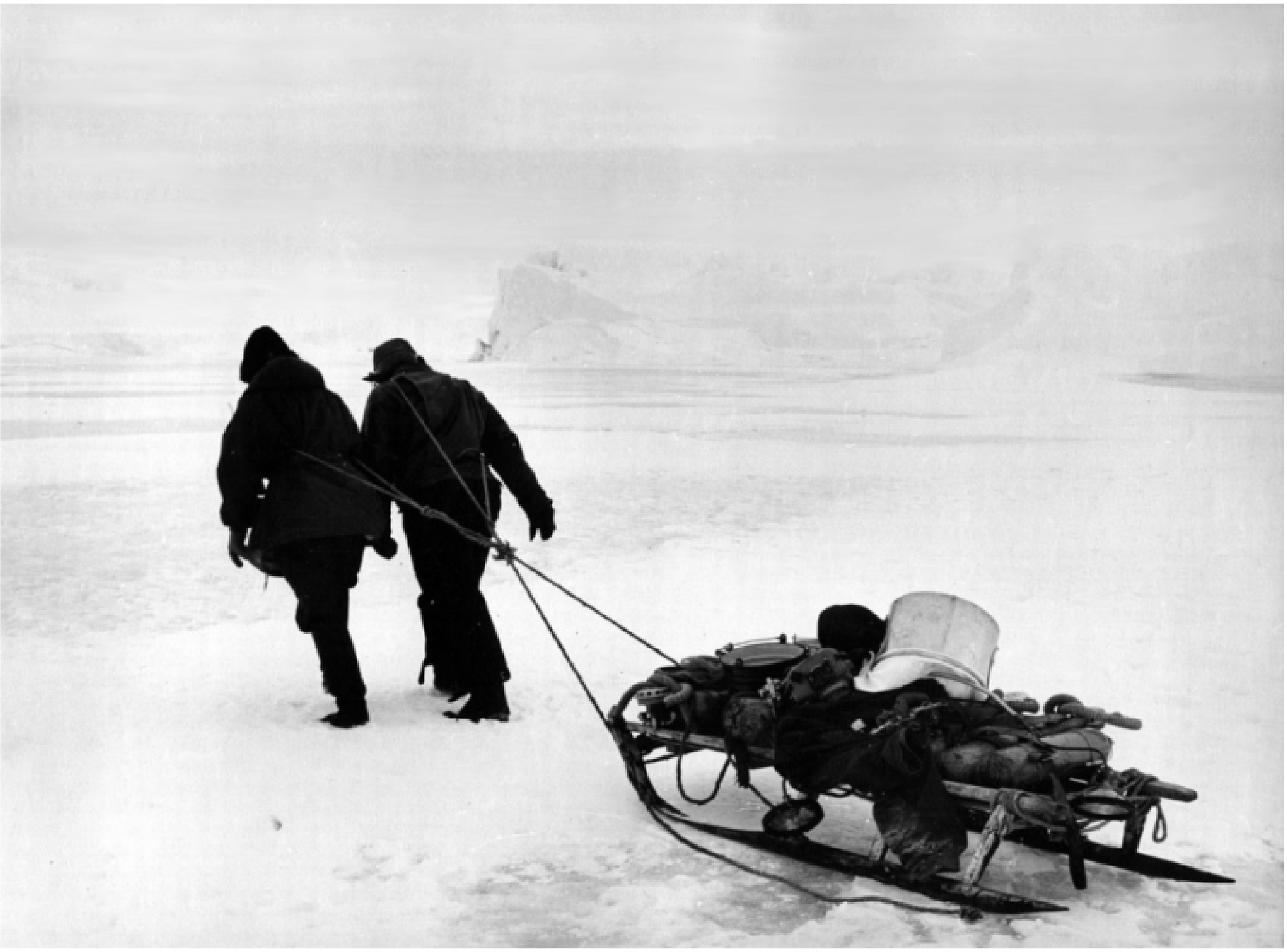


Alexander Pushkin collecting benthic animals on vertical wall, depth 26 meters at Tokarev Island in the Haswell Islands near Mirnyy Station, January 1966, 11th Soviet Antarctic Expedition (SIO Archives)

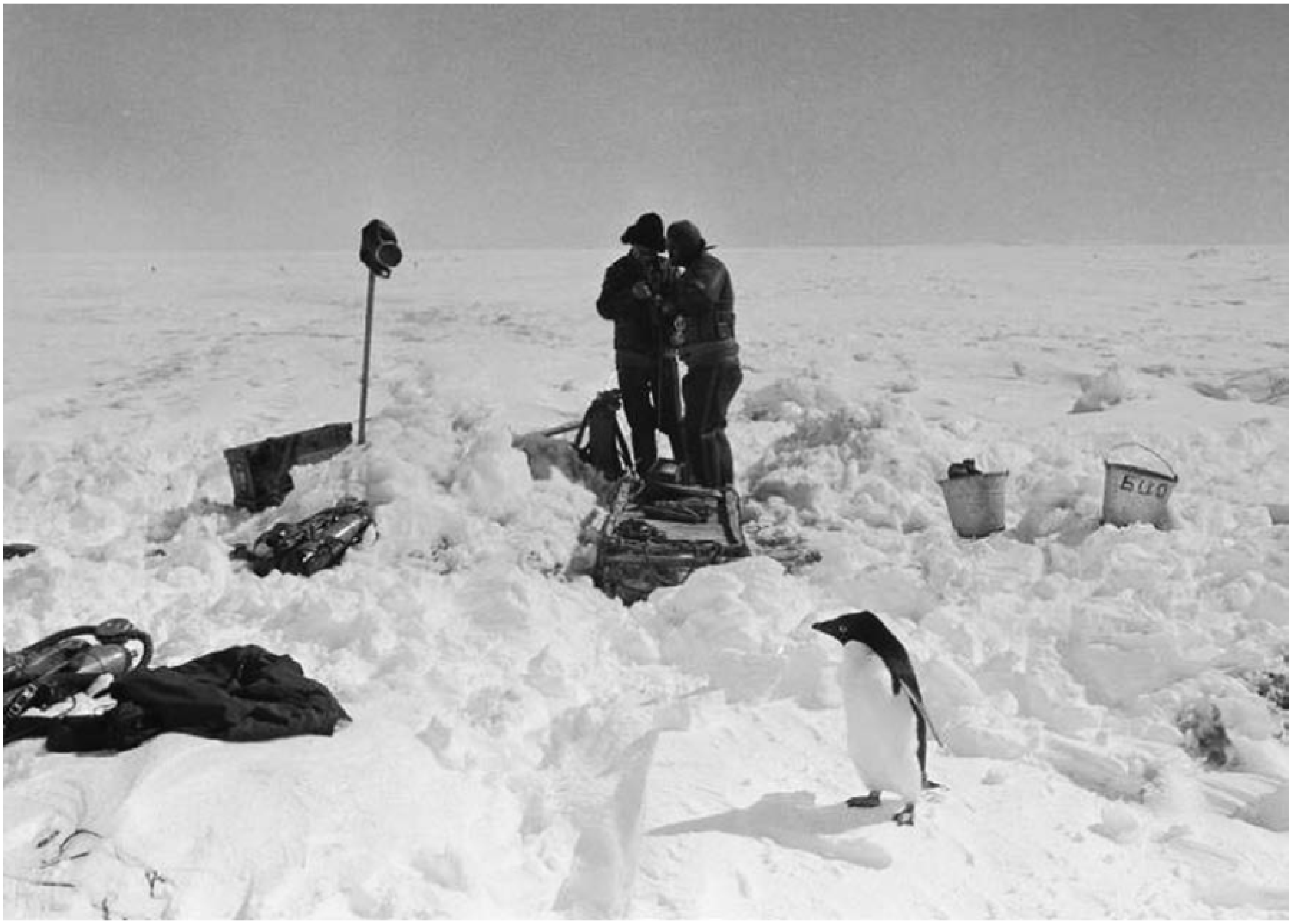
Diver at ice wall (not known whether it is Propp, Gruzov, or Pushkin) near Mirnyy Station, February 1966, 11th Soviet Antarctic Expedition (SIO Archives)



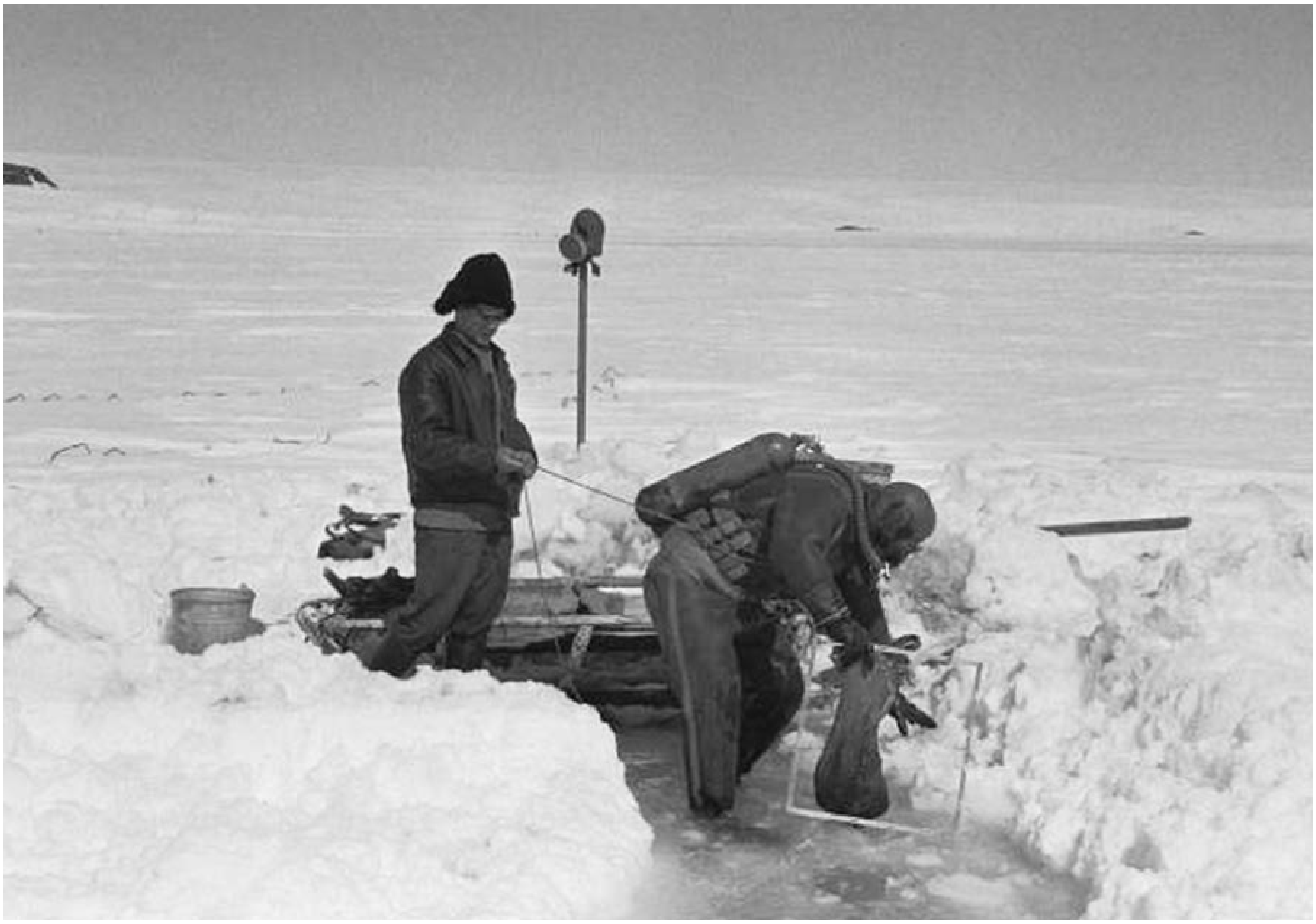
Alexander Pushkin with specimen collecting device, diving under ice at Haswell Islands near Mirnyy Station, January 1966, 11th Soviet Antarctic Expedition (SIO Archives)



Eugene Gruzov (left) and Alexander Pushkin (right) pulling sled with scuba diving gear to a dive site, February 1966, 11th Soviet Antarctic Expedition (SIO Archives)



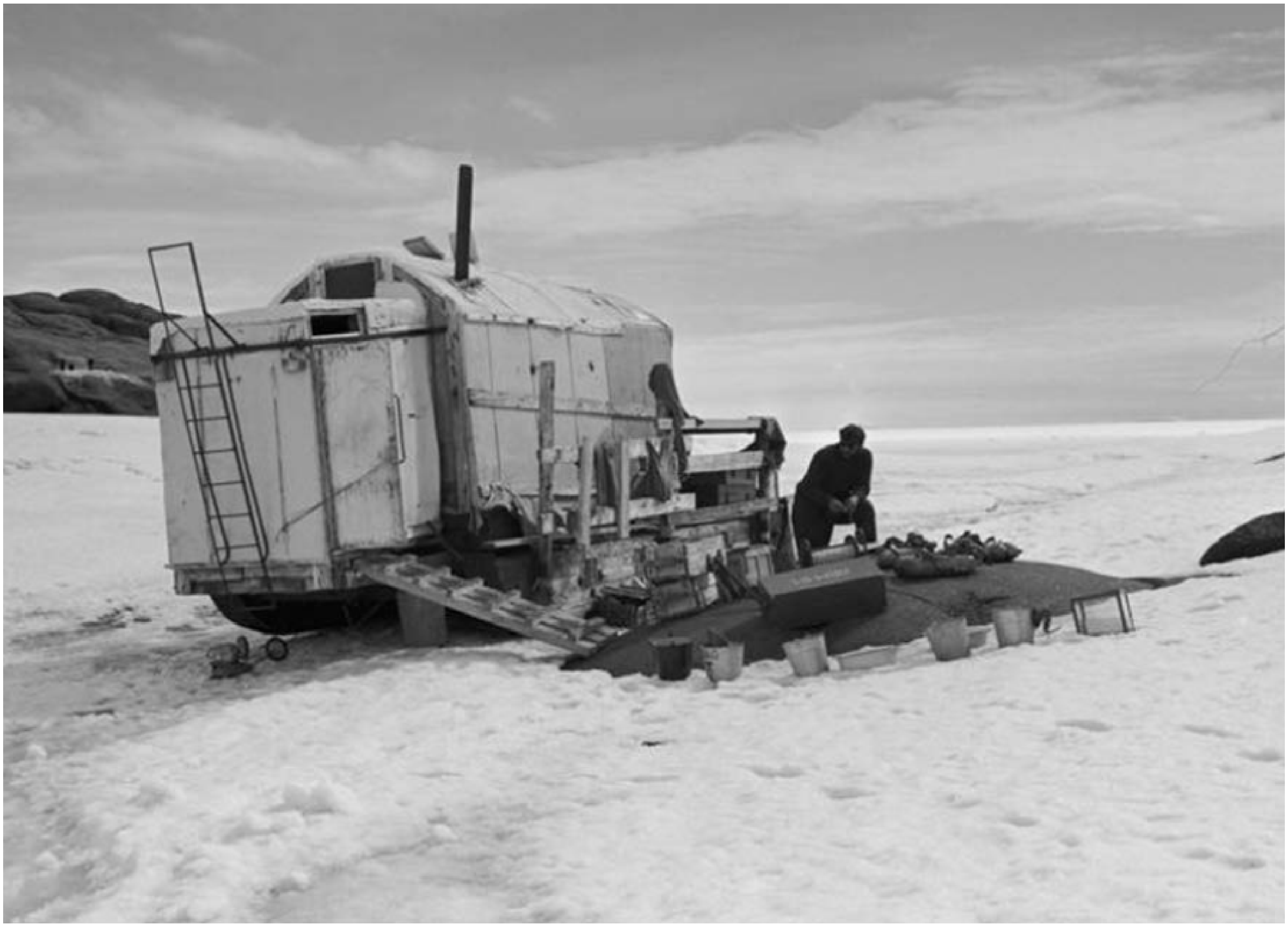
Eugene Gruzov (left) and Alexander Pushkin (right) prepare to dive in a hole through the ice, Mirnyy Station, February 1966, 11th Soviet Antarctic Expedition (SIO Archives)



Eugene Gruzov (left) assisting Alexander Pushkin (right) after a dive under the ice, January 1966, 11th Soviet Antarctic Expedition (SIO Archives)

Eugene Gruzov (left) and Alexander Pushkin (right) after a dive under the ice, 11th Soviet Antarctic Expedition
(SIO Archives)

Eugene Gruzov (right) and Alexander Pushkin (left) after a dive under the ice, 11th Soviet Antarctic Expedition
(SIO Archives)



Alexander Pushkin at sledge hut used for diving support, 11th Soviet Antarctic Expedition (SIO Archives)

Antarctic chapter from Beneath the Five Oceans, Thirty Years of SCUBA Experience. IN: Translation of: V glubinakh piati okeanov : tridtsat' letpod vodoi. M.V. Propp. Leningrad : Gidrometeoizdat, 1991. 255 p. ISBN: 5-286-00321-4. Copyright 1991 M. V. Propp. Reprinted by permission of the author from an unpublished translation, with image scanning and text editing by Peter Brueggeman, retired Director of the Scripps Institution of Oceanography Library of the UC San Diego Library.

The participation in the Zoological Institute's expedition had for me some informal consequences; during the work I made friends, and established contacts with colleagues. A young zoologist and diver Evgeni Gruzov became my friend. In Posiet it occurred to us to initiate research in Antarctic coastal waters. Soviet expeditions to Antarctica became regular after 1956 in relation with the preparation for the International Geophysical Year. They were extremely popular at that time, with more than five thousand applications per vacancy being submitted. In the years to follow after the International Geophysical Year the research program was reduced, but the permanent Mirnyi and Molodezhnaia stations on the Antarctic coast kept on working. There were not any traditional methods to study the communities of the shallow waters under the ice cover, and some of the coastal Antarctic areas were absolutely unexplored. As for the organization of the expedition, the matter was simplified by the fact that the Zoological Institute was the head institution in research of biology of the Antarctic, and Professor Anatoli Andriyashev, the then deputy director, was in charge of the work. Andriyashev was well known as a prominent scientist and respected for his magnetic personality.

Antarctic expeditions were organized at first within the Academy of Science, and then transferred to the Institute of Arctic and Antarctic subordinated to the USSR Hydrometeorology Service. One of its objectives was to provide navigation in polar areas. A polar veteran Evgeni Korotkevich headed the expedition. A leading scientist in polar geography, E. Korotkevich skied alone many kilometers in the little explored islands of Franz Josef Land and Severnaya Zemlya mapping them. Overloaded with management work as he was, he expressed profound interest to all the details of the Antarctic research. But for the concern and assistance of these two persons, their readiness to resume the responsibility for the new and seemingly dangerous undertaking of underwater exploration in the Antarctic coastal waters would have never been conducted in Russia.

Nevertheless, when in late 1963 we applied to A. Andriyashev the obstacles turned out to be too numerous. We were the beginners and they did not treat us seriously. When the International Geophysical Year was completed the research programs were considerably reduced, and it was almost impossible to include some new points to the programs. By summer 1965 after we had published the results of our work carried out with the use of SCUBA, the attitude to our proposals became more favorable. We started to prepare for the work in Antarctic.

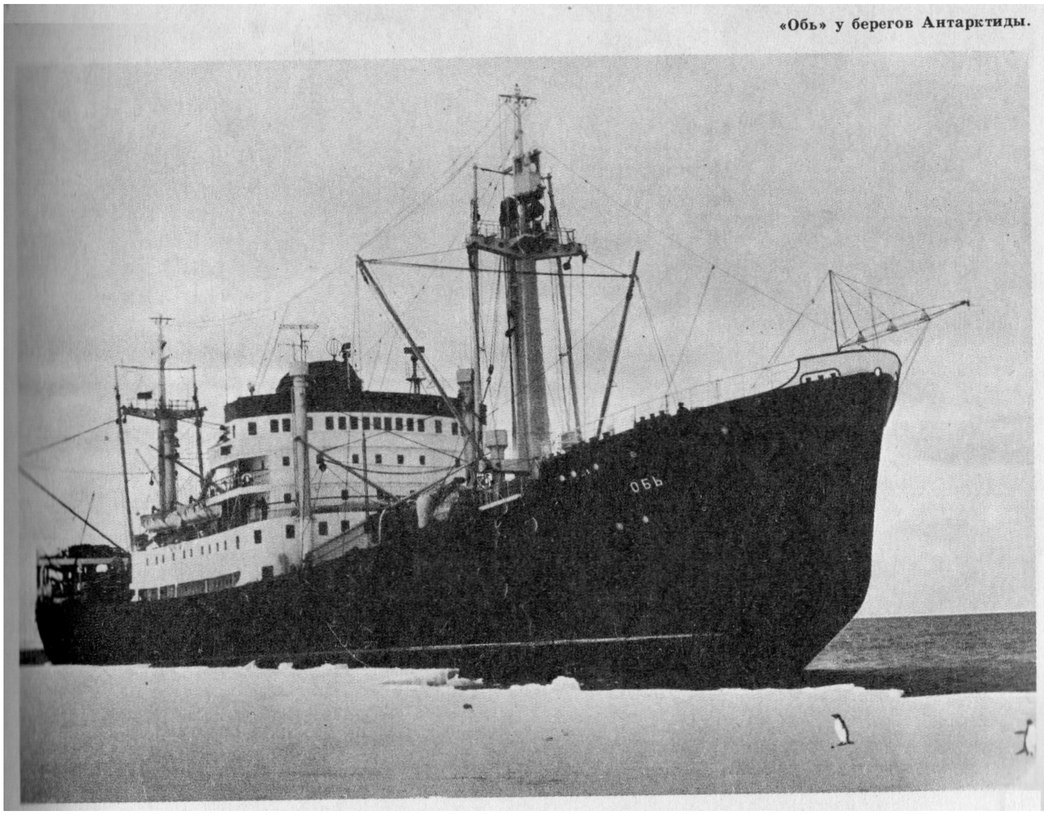
In Zelentsy we made a model of a foam rubber dry diving suit with high thermal insulation characteristics. Before that either foam rubber wet suits, or rubberized fabric dry suits were used. Although, as it turned out later, the American scientists who worked in Antarctica simultaneously with us, dived in common wet suits; their use in the extreme polar conditions seemed an act of heroism.

Our new suits were based on a dry suit design but were made out of foam rubber that in combination with several pairs of woolen underwear provided thermal insulation. If a suit got ruptured a diver could regulate the buoyancy by inflating it with his nose through special tubes. The diver’s head was covered with a rubber helmet. That gear turned out to be a success and was used for several years. In the second half of the 1960s I had an opportunity to try a Swedish Poseidon Unisuit, which was considered to be the best gear for a professional diver. I was amazed to find out that it was made using the very same principles we employed in designing ours. There were some slight differences like an unreliable pressure-sealing zipper, and a separate little tank to pump air, but the general likeness was striking. The Swedish Poseidon Unisuit was designed independently and made out of neoprene foam rubber reinforced with a nylon knitted fabric that made it stronger than ours.

Alongside with the improvement of the suits, it was necessary to improve the underwater cameras - the pictures of the unknown underwater world of Antarctic were sure to be of research and cognitive value. Camera boxes produced by the industry were primitive, unreliable and by no means could be used in Antarctic conditions. We had to develop for ourselves flash lamps that are required for shooting in darkness. Together with the divers Sergei Rybakov and Victor Vakhranev I spent long hours in the summer of 1965 testing and modifying our underwater cameras. We did not know whether it was light or dark under the ice cover, and just in case made telephone communication and underwater illumination gear. Fortunately, we almost did not have to use them.

Paper work was not so copious at that time, but the preparation for the work in the Antarctic was not at all simple or easy. Each one of us was busy seven days a week from early morning until late at night. Running ahead of the story I say that thorough preparation justified itself and we had no insurmountable difficulties or problems.

The Eleventh Antarctic expedition left for its destination place on board the "Ob" diesel-electric ship in November of 1965. The ship was far from being luxurious. The cabins accommodated four, six, eight and twelve people, were between decks, and had no ventilation, to say nothing of air-conditioning. In the tropics the temperature mounted to 40-45 C, and we spent all our time on deck. The "Ob" was meant for work in polar seas with an egg-shape hull that increased its resistance to ice binding. But due to that same shape she pitched and rolled during a storm, and in the Southern Ocean she had a 45 degree list.


«Обь» у берегов Антарктиды.

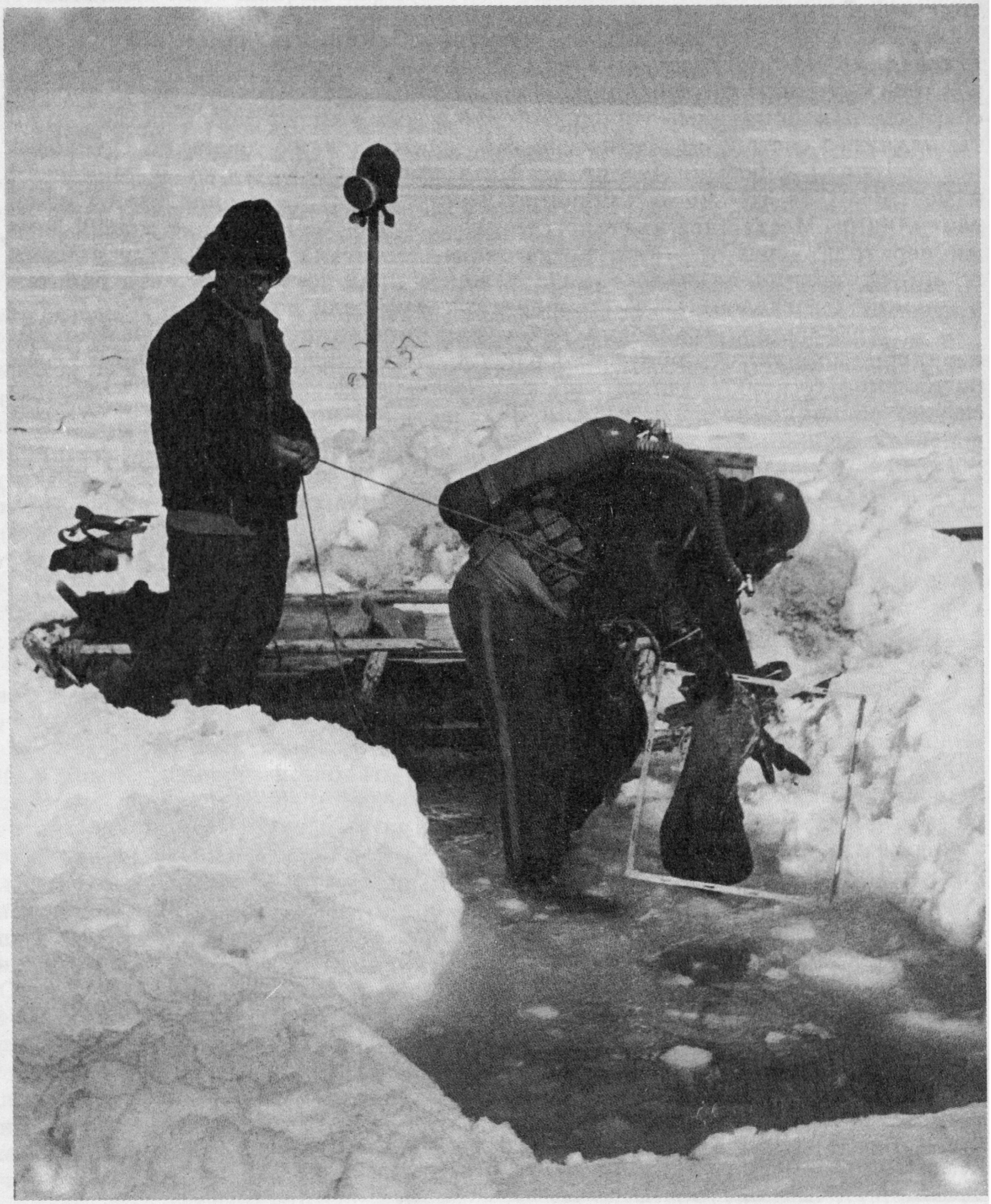
The Eleventh Antarctic expedition was held ten years after the Soviet research in the Antarctic began. The heroic period in exploration of the Southern continent was over, as well as the requirement for heroism and efforts beyond human endurance from polar explorers, but professionalism and a willingness to live and work in little comfort were still required. The same field money in the amount of twelve rubles per day were paid to every expedition member. Polar researchers earned enough to buy a car upon their coming back and obtained a special license so as not to wait in the general line. Yet, material issues were not of any great importance for the expedition members.

After a half-month voyage we finally reached the Antarctic shores, or rather the edge of thirty-kilometer deep fast shore ice surrounding the continent. While snow trucks, tractors and sledges delivered cargoes to the shore, we dived for the first time near the "Ob". We examined the underside of the floe ice which was smooth as a mirror and without any obvious traces of plants or animals. Our diving gear worked well, while expedition leaders became convinced that under ice diving was practically possible and was not fraught with mortal danger.

We installed in Mirnyi and started to prepare for diving. We began from a small island where oil storage was constructed and to where trucks went regularly. We cut holes in the two meter thick ice and measured the depth that differed greatly from the ones on the map. After a number of tries we found a site twenty meters deep. Using explosive we made a hole, cleaned it of floes and ice debris, and installed a tent nearby.

As if by a mere chance V. Leonov, our physician, appeared with his bag packed with medicines. Sasha Pushkin was the first to dive and I was his tender. Minutes dragged on, Sasha's breath echoed in the headphones. I could not help asking: "How is it down there?" Through the noise of bubbles came the indistinct answer: "Plenty of everything, can work". At these words my heart leaped. Uncertainty as to whether the results of our expedition would be a success, since many of the prominent scientists considered the Antarctic research unnecessary and regarded them as waste of money and time, gave place to excitement and presentiment of success. If everything, whatever it might be, was plentiful, we would work. I burnt with desire to see everything with my own eyes. 24 minutes had passed, enough for the first diving in new conditions, but too little for Pushkin who used to stay underwater for a long time. Finally, Sasha's head appeared above the water surface, and he passed me the collecting bag, filled with brainy specimens. Thick ice covered the regulator and hoses, and I helped him to take off the helmet. His words were short and vivid: "Plenty of everything, sea cucumbers, urchins, heaven, icy feet." I started to unpack the bag. The diversity of forms and colors was striking, particularly in contrast to the featureless, stark desert around; brilliantly colored sea stars, brazen orange soft corals, sea cucumbers, sea urchins of never-seen-before forms and colors, strange egg-shaped creatures, and forms more fantastic than the ones described in science fiction. The physician forgot everything about his medicines and our health, and could not take his eyes off the creatures emerging from the underwater realm.

Среди ледяной пустыни.



Back on the surface a diver becomes very talkative; we called it an incontinence of speech. This time I caught every word Sasha said. "Very cold, hands and face get cold, teeth ache from the air stream, but one can work. Water is like air, but blue, at first it is dark, and then it's like some fantastic garden - what is not, zonation, large depth is somewhere close". In the tropics we have lost any habituation to cold. In Antarctica the seawater is always at its freezing point of minus 1.8 Celsius. Every additional cooling, e.g. when the compressed air in a regulator expands, results in ice formation on the scuba equipment's surfaces. In ice-cold water the losses of heat from the suit surface are very great since its outer layer cools to a water temperature. Protection from overcooling becomes a factor of prime importance, with no trifles here; thoroughly considered were such details as the form and location of pockets on the clothes used over the diving suit. Hands are particularly sensitive to cooling, since they have the largest contact surface with water, finger diameter is small, and their blood circulation is slow. From the theory of heat transfer it is known that any thickening of heat insulation layer above some definite value results in additional heat losses. The optimal thickness of heat insulation layer for fingers makes up only several millimeters. Nowadays some companies produce heated insulating diving gloves, - they were not produced in 1965, but even today there are no gloves absolutely fit for working in ice cold water. Actively heated gloves did not spread wide open, and one had to rely on the fact that gradually the fingers and palms became less sensitive to cold. The process is slow and takes time. Thick woolen gloves of double knitting with a thin rubber glove put on above continue to be the most reliable. I descended into a hole and found myself in total darkness, and I got below the ice. The eyes gradually adjusted to a sharp change of illuminance (later measurements showed that less than a thousandth fraction of the surface light passed through the thick layer of snow and ice). Soft, dispersed, light-blue light never seen on the surface shed on everything around.

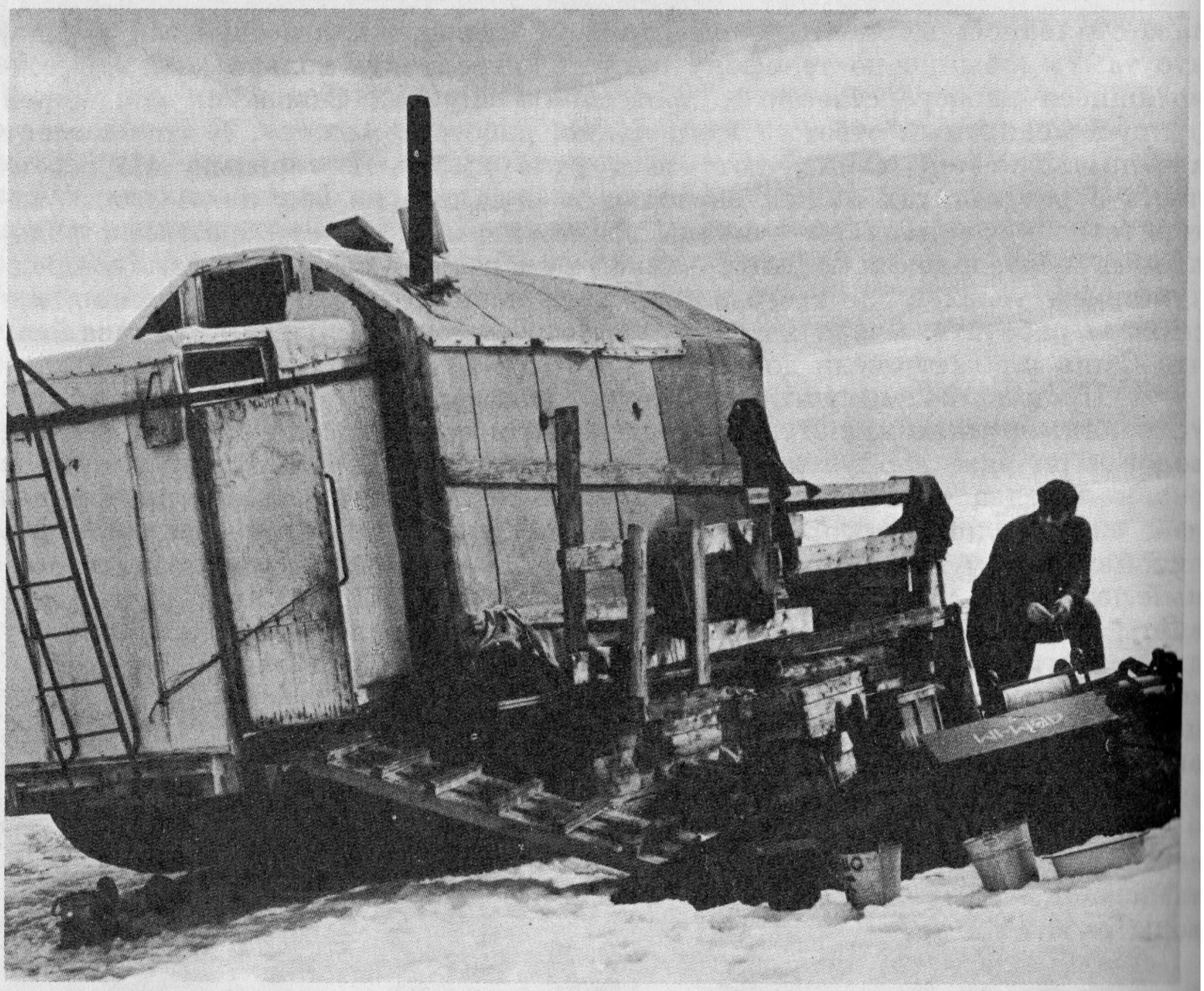
At a distance I saw the cliffs steeped to the depth. Gradually I saw that the underside of the ice and the nearby rocks are covered with ice crystals several centimeters long sparkling in a blue light. At a depth of 15 meters I touched the bottom - water transparence was striking; it was like pure air colored lilac-blue. Usually the contours of objects in water became indistinct at a distance and disappear into turbid water, while here they remained sharp but gradually vanished in a lilac distance. Nothing moved in that fantastic world, even fish at the bottom were as if entranced. When I touched a fish it swam reluctantly half a meter away and stopped still again. I was an intruder from another world with bubbles from my scuba lifting to the ice above. Here, in the Davis Sea human eyes for the first time saw the underwater world.

Под лед.

That motionless world was not at all dead, and was just the other way round; animal abundance was striking. Deep purple sea urchins resembling the ones in the Barents Sea and brilliant red sea stars were numerous among the ice crystals. I dived to a depth of more than 20 meters. Sea cucumbers very much like the ones in our Northern and Far Eastern seas covered the sea floor in thick carpet. They seemed dormant, their tentacles pulled in. Large, up to a meter in height, pink bushes of soft corals raised from the bottom, with thickets of sponges in the background. The quantity and diversity of small animals reminded me of a museum filled with the exhibits from all the seas and preserved in bluish liquid. I had to remember about the research tasks of our expedition, to divert myself from the surrounding beauties, and with an expert's eye started to estimate zonation in animal distribution, to single out mass forms and basic groups, to think how to organize the work. Meanwhile, I started to feel cold penetrating the rubber of a diving suit. First, fingers froze, than teeth ached in a stream of cold air from a mouthpiece, then with all my body I felt the ice cold water all around. I collected the most characteristic animals and went to the surface.

Удачные сборы.

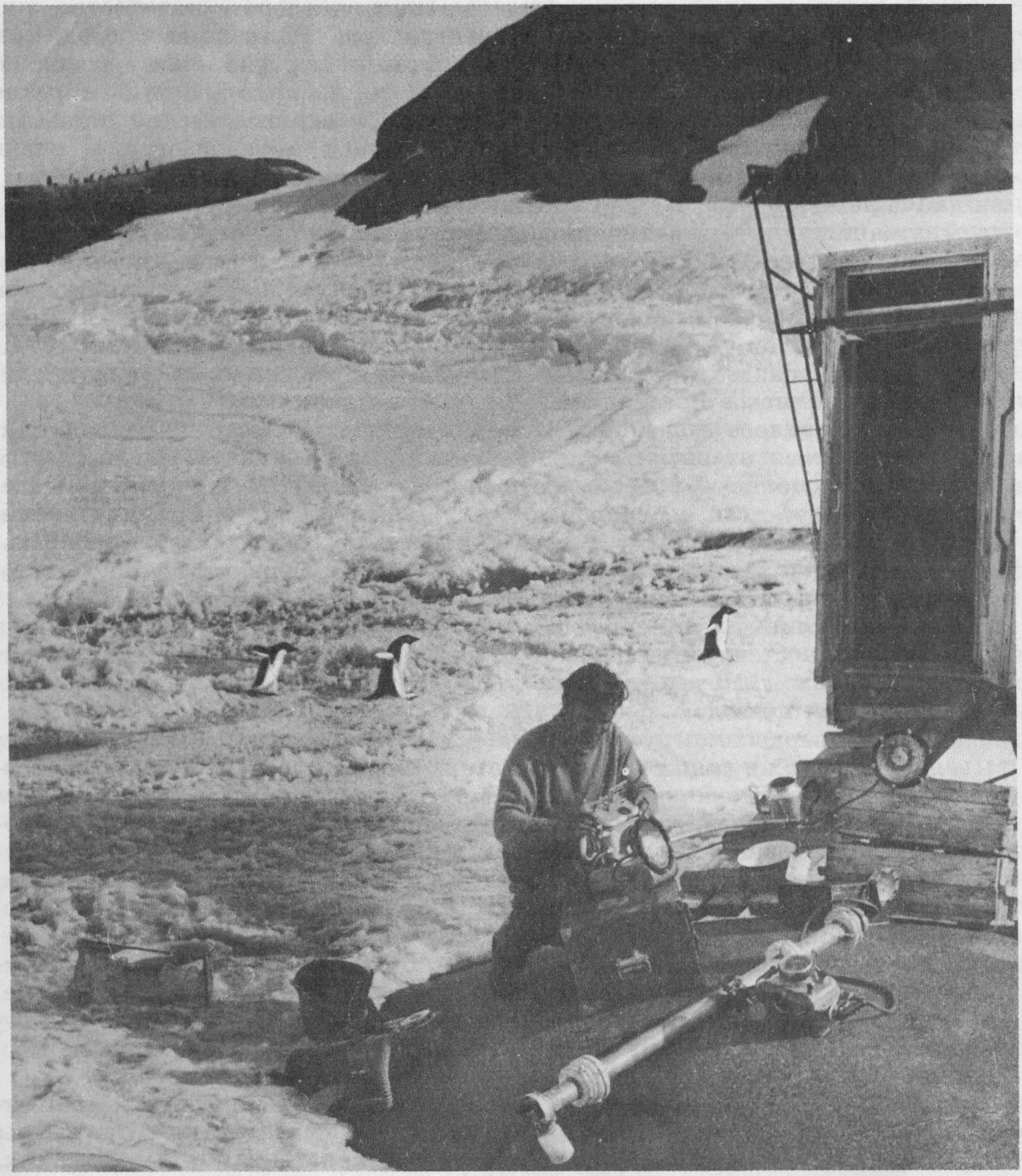
After our first diving we organized a base to conduct the work. A trailer on the sledges was allotted to us, and in it we installed all our equipment to study the samples. In the weeks to follow we dived, collected the samples, counted, weighted, wrote and attached labels, filled tanks, and did many other things. On those days, weeks, months we had nothing but our work and absolutely necessary rest. The high spirits we all were feeling are hard to describe. We dived more frequently and deeper, from time to time wrestling with the wind that struck the Mirnyi, took pictures, shot a film, and several times changed the location of a base.



Наше хозяйство на льду.

After two months of hard work, animal and plant distribution off Mirnyi was studied rather well. Sometimes we found animals mentioned in books, and we found ones we could not refer to any type. Later on, when we worked with the collections it turned out that in some groups up to a half of the species were unknown to science. We collected numerous samples of ice algae and animals inhabiting the underside loose ice layer. A. Andriyashev drew our attention to the new American data according to which not only the water column, but the underside of the floe ice is inhabited by algae. His idea approved later was that in Antarctic conditions these algae might have a determining significance in the productivity of the whole sea. In the end of our work which was completed in four months, Gruzov and I managed to fly to Molodezhnaya station where we held a reconnaissance for future work.

The description of the animal and plant distribution off the Antarctic, and the collections were a success, but there aroused many questions having approximate or no answers and demanding further experimental study. Sea floor communities of the Antarctic were represented by a great number of species. This difference from the analogous communities in the Arctic was obvious. At the same time the general laws of biological structure of the seas and oceans gave grounds to expect greater similarity. The most reasonable explanation for that is in the ocean history.



Подготовка к съемкам.

At the time of the recent - in geological sense - ice period, the Arctic Ocean at some point in time was covered with thick permanent ice below which only a few species of plants and animals could survive, with the rest becoming extinct. Later, in geological periods to follow when the ice melted in summer time, new inhabitants migrated to the Arctic Ocean from the North Atlantic and Pacific. In geological time scale the Arctic communities are young, and only some of the species managed to adapt to the severe polar conditions. The Antarctic continent is surrounded by deep water, and its shelf is shorter and steeper than in the Arctic. Glaciers cover nearly all of the Antarctic continent. Here, as well as in the Arctic, icing occurred, ice cover thickened, but its area increased inconsiderably, since the ice broke off at the shelf ledge forming icebergs. For millions of years the conditions were rather stable, and the majority of the inhabitants had enough time to adapt to low temperatures, resulting in considerable diversity of bottom communities. Still it is not easy to explain the diversity of the Antarctic bottom communities. In all the seas the basic producer of organic matter is tiny algae - phytoplankton. It is plentiful in Antarctica only during a short period of two months when the ice cover on the sea surface breaks. As early as February, enough light penetrates the frozen waters to initiate growth of a brownish layer of algae on the underside of the ice. This algae is a pasture for ravenous grazing by shrimp like crustaceans called amphipods. The amphipods attract Arctic cod, small pelagic fish that haunt the floe edge. The key link in the long polar food chain are ringed seals, cod, and sea birds that feast on small crustaceans. Nevertheless, bottom animals can feed on ice algae only during the short summer when the ice cover breaks, so the ways of energy transfer from plankton and ice algae to bottom dwellers are not yet quite clear.

During the four months' work in the Antarctic large collections were gathered, and observations were made that were praised highly afterwards. In 1968 A. Andriyashev, E. Gruzov and I made presentations on the results obtained at the International Antarctic Biology Congress in Cambridge, England, where they aroused interest. At the Congress we heard of similar research undertaken by American biologists at McMurdo station on the Ross Sea coast. At the same time it became clear that our expedition should lay the basis for a large research program. It was necessary to study thoroughly what we touched upon, to explore the bottom communities in some areas of the Antarctic, to conduct the all-year-round observations, to set up a biological station in the Antarctic to study the adjustment mechanism of the living marine organisms to the severe conditions. I wanted to plunge into that work, but at first had to complete the research conducted in the Murman and to write a thesis. E. Gruzov headed and completed successfully the next Antarctic expedition during which some new areas were studied, in particular the South Shetland Islands. I defended my thesis and planned to initiate the preparation for the expedition, but instead got into a hospital with septicemia. E. Gruzov prepared the Antarctic expedition again and, by that time A. Pushkin had joined the Zoological Institute staff, specializing in sea spiders which are particularly numerous in the Antarctic. Murmansk Marine Biological Institution had no participation in Antarctic activity any more.

By the time the Antarctic expedition returned I had started to dive again, but in the years to follow I could only dream of getting to the Antarctic. During these three Antarctic expeditions large quantities of material were collected, with the results studied for years at the laboratories of the Zoological Institute. The white spot in the Antarctic coastal water disappeared, but the next step forward - transition to the experimental study of the processes in these waters - has never been done in Russian Antarctic expeditions. To a large extent this was related to the fact that the Zoological Institute was the head institute in Antarctic biological research. The principal objective of the Institute was theoretical study of animal taxonomy, and experimental studies were not conducted in any significant scale.

To set up a biological station in the Antarctic, to staff it and provide with equipment and materials, to work out the long-term research programs required another institution, where the issues of physiology and biology were of prime importance, but there was no such institution then. After a promising start the Soviet underwater research in the Antarctic stopped.

Nevertheless, the results obtained were of great value, and everybody who participated in the work understood that we achieved great results. The published results made us known in scientific community. Polar diving was not regarded anymore as something fraught with danger, and soon a permanent team to study polar ice headed by V. Grishchenko was formed at the Institute of Arctic and Antarctic. They did not study biology at that Institute, but the existence of the team made it possible for the researcher I. Melnikov of the Institute of Oceanography to commence the study of polar ice at the North Pole drift ice stations. While studying the algae on the underside of floe ice and phytoplankton, he obtained exciting results. There were no direct link between our works in the Antarctic and this research, but they would hardly have been possible before our diving off Antarctica.

THANK YOU FOR YOUR TIME & INTEREST, Mikhail Propp. Photographs may not be used in any form without the permission of the photographers. Propp/11th Soviet Antarctic Expedition photos ©University of California Regents, University of California San Diego Library, Special Collections and Archives.

REFERENCES CITED: 1: Vodolaznye Gidrobiologicheskie Raboty v Antarktike. YN Gruzov, MV Propp, AF Pushkin. Informatsionnyi Biulletin Sovetskoi Antarkticheskoi Ekspeditsii 63:45-51, 1967 (translated in: Soviet Antarctic Expedition, Information Bulletin 6(5):405-408, 1968); **2:** Biologicheskie Soobshchestva Pribrezhnykh Raionov Moria Deivisa (po Rezul'tatam Vodolaznykh Nabliudenii. YN Gruzov, MV Propp, AF Pushkin. Informatsionnyi Biulletin Sovetskoi Antarkticheskoi Ekspeditsii 65:124-141, 1967 (translated in: Soviet Antarctic Expedition Information Bulletin 6(6):523-533, 1968)